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KINEMATICS AND DYNAMICS OF INFORMATION IN MEDIA SPHERE

SŁOWA KLUCZE: Przestrzeń medialna, kinematyka informacji, dynamika informacji, wektorowe odwzorowanie informacji, kojarzenie informacji, generowanie informacji w mediach

KEY WORDS: Media sphere, kinematics of information, dynamics of information, vector representation of information, associating information, generating information in media

Abstract

In humanities and natural sciences, the media sphere is treated as a complex, abstract object used for describing the processes of media-based social communication. The concept is objectified and can be encountered in terminology employed in such fields as sociology, psychology, information technologies, cybernetics, the Internet, study of information society, as well as sciences of market economy, study of law and even organizational learning. Generally speaking the media sphere is a social sub-sphere and comprises the following sets of elements: media, information items, associations, senders and recipients. Each of these groups is time-dependent and changes significantly in a fractal-like manner. In this sense, we can talk about kinematics of this sphere and compare it to methodology issues connected with the area of physics. What is more, elements of the media sphere are affected by external factors. Therefore, it is possible to investigate the dynamics of the media sphere.

According to sociology and other social sciences, the social sphere is a result of activities performed by individuals and groups in order to satisfy their needs. It is generated through individual and collective operations executed by people who recognize its specific importance, value and properties. It can also be studied as a distance measured in a different way than other types of space, e.g. physical space[1]. The social sphere is projected within the abstract information sphere, just like the entire environment. In this sense, the media sphere becomes a distinctive part of the information sphere reflecting all events and facts taking place in the social sphere. The limits of such distinction are

[1] *Słownik nauk społecznych* (*Dictionary of sociology*), G. Marshall (ed.), 2004.

determined by the media (media entities)[2], which in legal, formal, market and organizational terms constitute the "media system"[3]. Within an information society, individuals, as well as institutions and organizations established by them operate as media entities within the media sphere. Media entity is a general concept used for describing one of the elements comprised in the media sphere, and it is also applicable for such concepts as: "media system", "mass-media market", etc. Media entity does not only denote mass media but also people (each of us), who as a result of progress in technologies (media digitization) and thanks to multimedia networks, participate in the process of media-based communication. Within the media sphere, accumulating modern and constantly emerging technical means of communication, a media entity has unrestricted, interactive access to information "as it comes", in real time. Due to this he or she must be able to effectively distinguish facts and events from comments and opinions, as well as advertising from information. Operating in every society, the media system (television, radio, press, Internet, next-generation mobile telecommunications, multiplex services) includes digital tools for mass communication, designed for sharing information about events, the state of social structure and relations occurring within it. It also contains tools for professional advertising and marketing as well as other endeavours connected with constructing the reality of the media sphere. Each piece of information has specific contents and value (weight). Information, as a rule, is treated as a relationship (link) between data. Hence, from the semiotic point of view, a sequence of "zeros" and "ones" (or other signs) carries a specific sense (meaning) attributed to the signs by the sender and recipient. Most frequently the content of information is a multi-term, digitally recorded image of that sequence, and its value (weight) is the emotional involvement of the media entity in the mental representation prompted by the information. In this sense, the most important issue for the existence of information within the media sphere is the process of creating mental representations and constructing the message from them. The process mainly involves associations between various information items constituting the message and resembles that which in psychology is called associative memory. The latter concept relates to one of the most important functions of the human brain whereby it processes, stores, and interprets pieces of information and their content. A model of such associative memory in accordance with cybernetics approach was proposed in the 1960s by Prof. Maria Kempisty[4]. In general terms, the concept was based on mathematical and logical description of associative memory treated as a huge number of interconnected activities and processes rather than as a static self-contained unit. The point is that the cybernetic model of associative memory resembles human memory, where it often happens that when we absolutely do not need a given

[2] Definition of "media entity" based on Pietrzak H. *Nowe podmioty w przestrzeni medialnej (New entities in media sphere)*, the book submitted to be published by Wydawnictwo Uniwersytetu Rzeszowskiego, 2012.

[3] Definitions of "media system" are to be found in a number of text books, e.g. T. Goban-Klas *Media i komunikowanie masowe. Teorie i analizy prasy, radia, telewizji i Internetu* (*Mass media and communication. Theories and analyses of press, radio, television and the Internet*), Warszawa 1999.

[4] M. Kempisty, *Pamięć skojarzeniowa – model cybernetyczny* (*Associative memory – cybernetic model*), Warszawa 1963.

thing or object we suddenly realize where it is, what it looks like, etc., or we experience a thought which is absolutely unrelated to the present situation or event. This happens because we associate a signal, which has just been registered by our mind, with another situation, place or object. We do not have to be aware of the first association between a signal and place, situation or object, yet when an impulse has reached that place it has excited one more path which has significantly enhanced the strength of the impulse so that it has affected our consciousness. This means that, firstly, in our memory the so-called path of associations is a way to reach a desired piece of information, and secondly, an association which occurs one way, does not necessarily have to occur the other way. This happens because of the anchoring process in our memory, where a given piece of information is remembered after it has been linked with previously existing concepts rather than as an independent unit. Then, by way of associations we can easily and quickly access the items, thoughts, descriptions of interconnected facts and events which are interesting for us. This way we can learn quickly and effectively, determine and infer the logical order of events, formulate current opinions, create future situations and events. This process is always extremely effective because when we evoke a concept or piece of information (by thinking about it), its connection with information previously anchored in our memory becomes stronger. More significant an emotional attachment is formed. In very general terms we can say that the entire media sphere is built on a network of associations between isolated pieces of information, or sets of information items which are employed by media entities in creating the message.

The impact of new technologies in the area of media digitization eliminates the differences formerly observed in opinions concerning methods and types of communication. The issue was already discussed by M. Poster in *Cyberdemocracy: Internet and the Public Sphere*[5] where he defined the concept of cyberspace, not as a network of relations, a kind of electronic geography, but as a social sphere whose infrastructure is employed for establishing new relationships and forms of interaction between people, or broadly understood media entities. In mediatised cyberspace, communication can be studied as a virtual multidimensional network of places, at the macro and micro level – the first specifies the network as a real object used for distinguishing place and space; while "micro" is understood as a real representation of people and their behaviours, both at individual and collective level[6]. Furthermore, Batty focused on essential concepts useful for describing each space. These are: "nodes" and "nets", identifying the locations of equipment used for processing, storing and presenting information, as well as a new concept of infrastructure used for transmitting information. Both the "nodes" and the "net" are employed for distinguishing the space itself, by creating an abstract construct functioning exclusively within its limits. "Node" is a "place" – the point of connection where the transition into the space of information occurs (more precisely

[5] More about the issue in: M. Poster, *Cyberdemocracy: Internet and the Public Sphere* based on: http://www.gold.ac.uk/difference/papers/poster.html [accessed: 09.01.2013].

[6] This understanding of network and its interdependencies was proposed by Batty M. in: *Virtual Geography;* based on: http://www.casa.ucl.ac.uk/publications/virtualgeopraphy.html [accessed: 08.02.2013].

"cyberspace"). Today cyberspace is understood as the space in which communication occurs via interconnected computers – it has become synonymous with the Internet and the worldwide web. Cyberspace is not "mappable" in any direct relation to real places and events. Neither is it created by individuals participating in the act of communication. Batty's typology provides a tool for precise identification of the place in which mediatised cyberspace functions and for defining it through interactions between media entities. In the media sphere the transition from the "nodes" to the "nets" during communication process takes place via media entities' interaction with information.

If we additionally assume, in accord with D. Gelernter[7], that information items, released from a specific location within any devices, float in the cybernetic space (he calls it *cybersphere*), then they can be accessed, when needed, at any time and from any place. This understanding of information space, and consequently the media sphere, conveys the whole idea of network. Time is the most important aspect of information space because it is responsible for ordering information items according to their meaning, significance, hierarchy, locations, etc. This is more natural for people who have always organized information along temporal scales, because indeed life also "flows" and it is much easier to associate information with a given stage of our life than with locations of events, and to realize how we perceive the world – the entire surrounding reality. In our thought processes we use mental imagery, and this way we visualize the reality and its specific components, or even concepts. Mental image always depicts a given object or mentally represented situation. Therefore, paths of associations involve links between properties of objects in relation to a currently perceived reality; searching for the essence of objects, events, facts – information, which should begin with associations previously existing in both the distinguished social spheres and in our memory, as well as searching for emotions familiar to us and expressed in the code of communication. Created this way, a "map" of the encountered object, event, or fact constitutes information containing an emotional component reflecting our attitude. Yet, we live in a specific environment (identified in social, political, cultural and traditional terms) and it contributes to shaping certain general patterns of associations, which spread across our consciousness in a subjective and unique way for each individual. An item of information builds its place in our memory starting with the first stimulus which it emits (object, event, fact – information), then travels across identifiable places throughout our cognitive space, to finally spin out the limits along the ways connecting the associations and to get anchored at its own place in the memory. This occurs by means of contrasting, internalization, interplay of senses, etc. It is important to cover a wide range of associations, yet the differentiating mechanism is frequently linked with the way these associations manifest.

In identifying the structure of the media sphere an important aspect is the media-based development and processing of "items of information" which are also elements of the information space. The society structuring the "media sphere" needs media entities in order to implement its subjective and objective functions, and for

[7] D. Gelernter, *Mechaniczne piękno. Kryteria estetyczne w informatyce* (*Machine Beauty: Elegance and the Heart of Technology*), Warszawa 1999.

direct and ongoing access to "information" dynamically changing in varying social spheres. Identifying and understanding current relations between the existing items of information, facts and events, their history, present and future, is an all-important factor for the dynamics of social development. In most undertakings people associate information, facts and events maintained in memory, particularly if such information is emotionally sensitive; they create a subjective structure of associations, yet this process is one-dimensional as visualization, imagination and inspiration relate exclusively to one individual. He or she exudes out into "space", his/her opinions, feelings and projects, i.e. final products of his/her own memory and receives back from it information which enriches his/her association processes, allowing for new understanding of a situation which then is forwarded as a feedback to other entities' associations. In this sense associations are multi-dimensional, and broadly understood "media sphere", as a multidimensional space, becomes a technologically convenient space for carrying out the process. Therefore it would be a good solution to create a "map of associations", in other words a primary matrix, which in its "informographs" containing address memory (memorates) organizes and classifies initial spatial associations, facts, pieces of information and events[8]. The following figure illustrates such schematic net of associations between pieces of information:

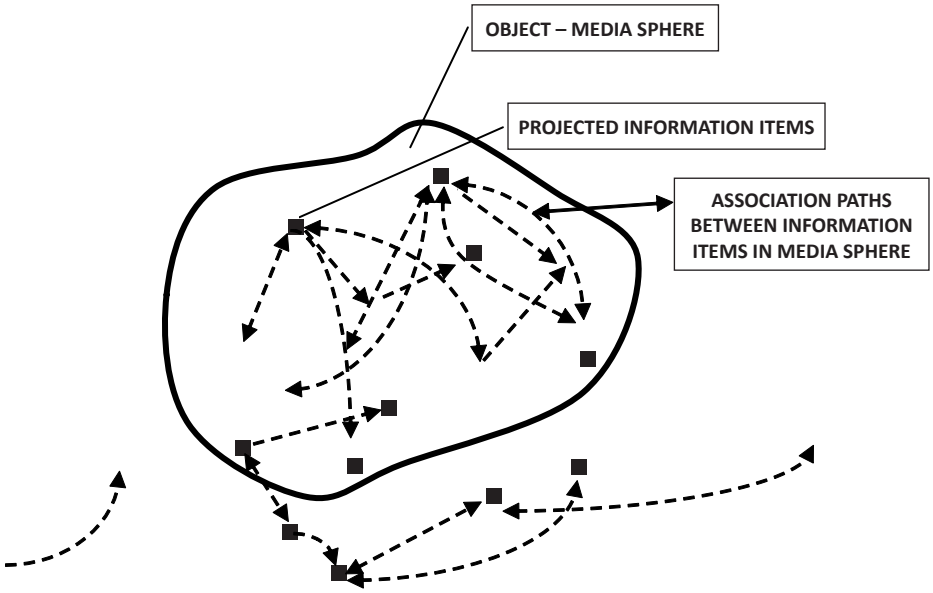

Fig. 1. Network of associations between information items

[8] Definition of informograph and address memory, the so-called "memorate", in: M. Kempisty *Pamięć skojarzeniowa – model cybernetyczny* (*Associative memory – cybernetic model*), Warszawa 1963.

Mediatised information space tends to be modelled after the typological concept of metric space[9] and it should be understood as a generalization of Euclidean spaces (plane, three-dimensional space). In this sense information space, and at the same time media sphere, is a simply connected compact 3-manifold without boundary, homeomorphic to the 3-sphere. Greatly simplifying, this means that if an object can be tightened to a point and then expanded with no need to break or glue together, it is a three-dimensional sphere[10]. Metrics can be determined not only in Euclidean spaces and sets (for instance a set of words or functions) but also for very abstract spaces, such as information space. While introducing the concept of distance (metrics) we can also introduce the concept of the limit of sequence or function, therefore we can use mathematical analysis for them"[11]. From the viewpoint of the theory of information itself, L. Brillouin[12] wrote that "quantity of information as a measurable value is of importance for the purposes of information processing and transmitting as well as for identifying its laws and limit". The value of information is a subjective category relative to an observer. Information contained in one sentence of a newspaper article, in radio or television news is meaningful for me but for another person may be of no significance. The value of information is not mainly a philosophical category. It can be defined, measured and analyzed. This has been discussed by a number of Polish authors, e.g. Oleński, and Dziuba, as well as by foreign researchers, e.g. K. J. Arrow, J. Riley et al. This obviously is connected with many difficulties, e.g. subjectivism in assessing the value. On the other hand, such issues as: classification and qualities of information gain importance. Furthermore, the definition of information, particularly the one based on alphabet or sets of symbols with various a priori probabilities, describes its properties, correlations and methods of identification. Particularly important for describing "information space" is the system of identifying elements of information accumulated in space, their number and the optimality criteria with respect to communication and decision systems[13]. Summing up: it seems there are grounds for speaking about information space, as well as possible subjectively or objectively distinguished "sub-spaces", e.g. strictly understood "media sphere" and that the space, i.e. information space with its emitting entities and technical means of mass communication is a media sphere which can be described as a vector-based mathematical model taking into account both scalars (e.g. coordinates in the space) and vectors (e.g. speed of movement). Vector space fulfils specific conditions: it contains a set of vectors; vectors can be added and subtracted. In such description information items are shown as points, and the space itself is not a stable object – it evolves in time. The speed of the process depends on a number of factors, including: the type of communi-

[9] Such approach based on game theory was adopted by: J. Kazimierczak, *Teoria gier w cybernetyce* (*Game theory in cybernetics*), Warszawa 1973, p. 199.

[10] J.J. O'Connor, E.F. Robertson, *Henri Poincaré* [in:] *MacTutor History of Mathematics archive*.

[11] Based on: metric space sjp.pwn.pl/haslo.php?id=2511267 [accessed: 20.01.2013].

[12] Based on: L. Brillouin, *Nauka a teoria informacji* (*Science and theory of information*), Warszawa 1969, p. 19.

[13] In-depth discussion of these issues is presented by: A. Dąbrowski, in the book: *O teorii informacji*, Warszawa 1974.

cation, external factors, and interactions (associations and relations) between pieces of information, and between these and media entities. Therefore, in order to describe media space in terms of quantity and quality it is necessary to define the concept of information and its behaviour in time. By adopting such an approach we can investigate kinematics and dynamics of media sphere.

Kinematics is a branch of physics which, generally speaking, investigates geometrical properties of the motion of bodies (material objects) without consideration to their other physical properties. Information has a physical nature, and in a spatial system it is exactly this type of object. In communication processes such an object is a specific "information system"[14] distinguished by the recipient, or more precisely the state "distinguished" from another one reflecting back the communicator's distinguished state[15]. According to this understanding, information in its physical sense can only relate to the system which is able to receive it, or reflect back the distinction of the communicator's "distinguished state". Information is not an inherent characteristic of the communication containing it, but belongs to a collection of objects from which the communication originates[16]. In this sense we can talk about the diversity of such collections, measure the entropy of information, identify its classes, qualities, and labels, etc.[17] Objects, including information, move in space, therefore we can apply here the basic concepts of kinematics, such as: space, time, position, coordinates, motion path, speed, acceleration, angular speed and acceleration, path, vector of displacement, shift, etc. For the needs of their spatial description these concepts should be represented in the multi-dimensional media sphere by scalar values (e.g. position) which will describe scalars and vector values (e.g. speed). Formally, vector space is a set of objects (vectors), where two operations are specified: adding elements of space and multiplying by elements not comprised in a given set (a body whose elements are scalars). Vector space is also called a linear space. Examples of vector spaces are: $V = R^3$, $V = R^k$, space of matrix (with real dimensions) sequences, and functions. Therefore, if media sphere is a vector space, it is necessary to show in what way vectors are added and scaled. A space of qualities is formed within media sphere. To investigate it we need a structural representation described by the division of vectors into classes. Using automatic classification we will identify objects extending and defining media sphere. The following figure illustrates the concept of vector-based representation of information in the media sphere:

[14] In my latest book *Nowe podmioty w przestrzeni medialnej* (*New entities in media sphere*, Rzeszów 2012) I have proposed a concept of such "information system" for the processes of media-based communication. The "system" consists of three elements: a name identifying information, a distinguished system which describes it in terms of its contents and makes it possible to determine the so-called "inter-contents similarity", as well as "address" locating the information in media sphere.

[15] K. Boruń, entry for "Information" [in:] *Mały słownik cybernetyczny* (*Concise dictionary of cybernetics*), M. Kempisty (ed.), Warszawa 1973, p. 155.

[16] W. Ross Ashby, *Wstęp do cybernetyki* (*An Introduction to Cybernetics*), Warszawa 1963, p. 177.

[17] Op.cit., p. 178, 247.

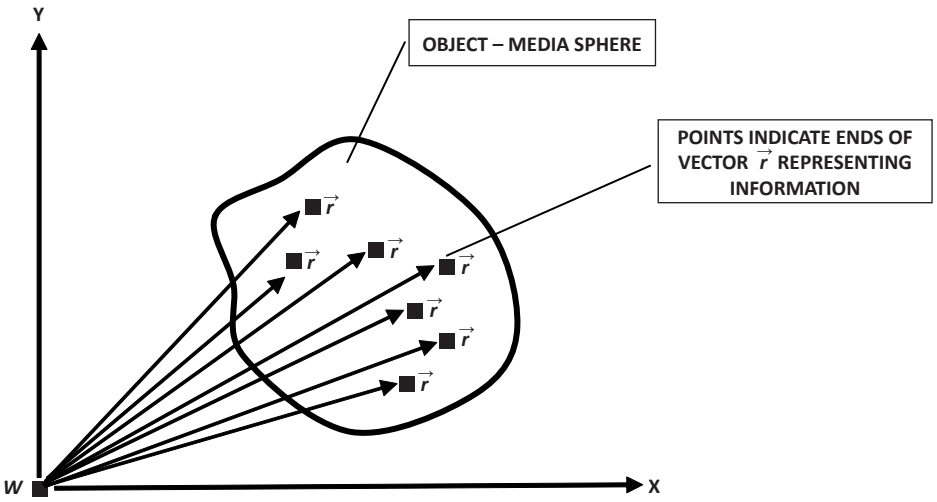

Fig. 2. The principle of mapping information with vectors in media sphere

One of the essential issues of kinematics of information in the media sphere is the speed of information, for instance in terms of its transformation from "data sphere". Information space holds various information items, related to "what was" and to what is currently happening. Not all of these become objects of the media sphere, and only few of them, described in terms of vectors, are positioned in media and stretch out the "spindle of information"[18]. Figure 3 illustrates the general principle. Information items from data sphere $\boldsymbol{i}(1)$, $\boldsymbol{i}(2)$ ..... $\boldsymbol{i}(6)$ belong to information space and characterise a specific event. In their communications media entities use information items $\boldsymbol{i}(1)$, $\boldsymbol{i}(4)$ and $\boldsymbol{i}(6)$, at different times, and with varied positioning. The speed of communication will depend on the process of associations between a media entity and information item and that process will directly impact the item's positioning. Therefore it is important at what speed the information will be placed in space.

Data defining and describing an event, and consequently information on object $\boldsymbol{O}_1$ in the event sphere $\boldsymbol{O}$ is represented in the information space $\boldsymbol{I}$. The process of transforming information, supplementing data and their representation in the information space occurs constantly. Within the abstract area of constant information mapping envisaged between $\boldsymbol{O}_1$ from the event sphere $\boldsymbol{O}$ and that object's representation in information space $\boldsymbol{i}_1$, and depicted by the "spindle of information"[19], informa-

[18] The concept of the "spindle of information" as a graphic presentation of media-oriented characteristics of information in space has been described in my book *Nowe podmioty w przestrzeni medialnej* (*New entities in media sphere*), Rzeszów 2012.

[19] Idea of such "mapping" which I call "spindle of information" has been described in my book: *Nowe podmioty w przestrzeni medialnej* (*New entities in media sphere*), Rzeszów 2012, p. 165–180 and next.

tion items, in terms of their "weight" and "value" as well as contents are identical in the distinguished area, i.e. the area in which we investigate and analyze kinematics and dynamics of information. Only its reception time is different, therefore it possible to examine and predict its kinematics and dynamics.

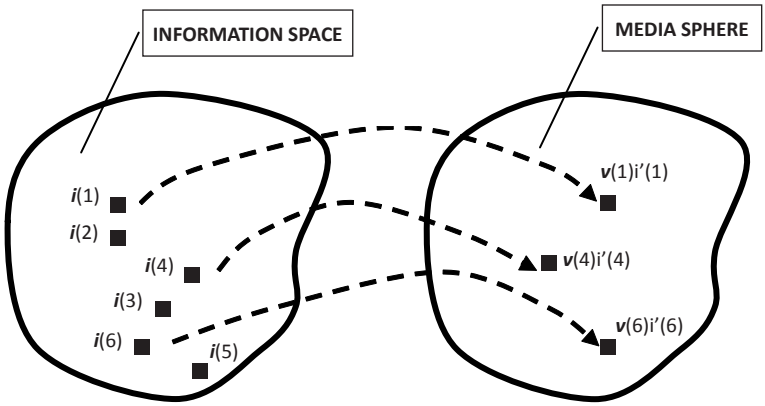

Fig. 3. Vector-based mapping of information from information space to media sphere

Fig. 4 shows that there is also a possible change in the "representation" (in the first area of representation we have a different point $i1(t1) \neq i1(t2)$). Unfortunately, a change in the method of representation usually leads to problems, e.g. difficulties with accessing the information (digital in the computer) rather than analogue on paper. This results in a subjective change in the significance of information (if inaccessible, it is usually considered to be less important than accessible information), yet this is not the only difficulty. As time goes by, the quality of information is changing, e.g. a part if it becomes outdated. This leads to a number of new problems and effects, which I am going to study further in my research. The general principle of such mapping is shown in Figure 4.

Dynamics is a branch of physics (mechanics) describing motion of material objects affected by forces. It describes movement of an object affected by forces alone, and depending on the mechanical model we distinguish various types of dynamics, including the dynamics of a material point[20]. Information is physical, therefore it is possible to study its motion and behaviours in media sphere by employing the principles of dynamics of material point. Time is a distinguished element of attribute vector for movement in media sphere, because changes of information are significantly impacted by it, e.g. positioning of an information item by various media in the same time slot. There may be different changes in the position of information. In media, in-

[20] B.M.Jaworski, A.A. Ditłaf, *Fizyka. Poradnik encyklopedyczny* (*Physics. Encyclopaedic guide*), Warszawa 1966, p. 43 and next.

formation on an event in the public sphere may be positioned relative to the type of media (sub-local, local, regional, national, etc.) or depending on the adopted (scaled) classes of positioning. In the same time slot $t_0 + t_1$ in various media, information items i1 , i2 , i3 .... iN change, with specific speed, their position into vi'_1 , vi'_2, vi'_3 .... vi'_N. The following figure shows the essential idea of the new approach to the concept of information dynamics in media sphere, exclusively in terms of its positioning.

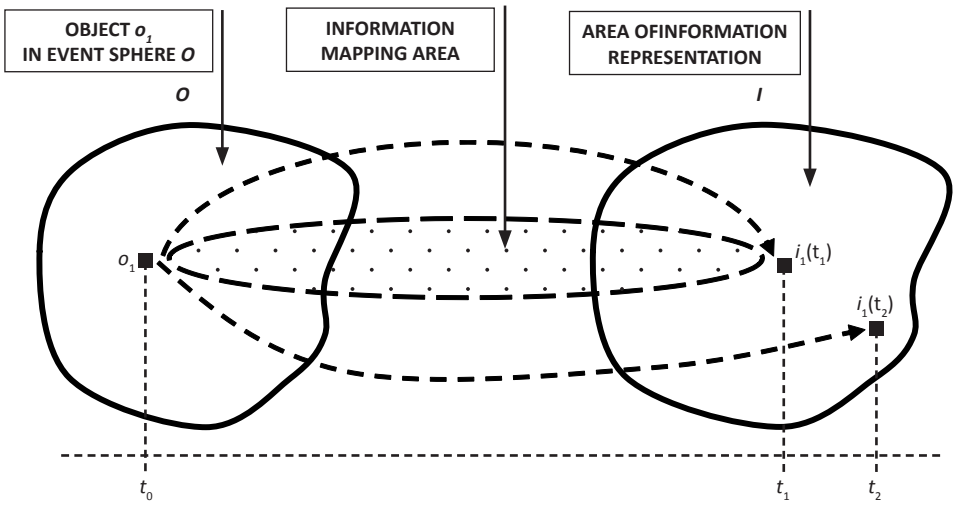

Fig. 4. Temporal variables in information mapping $\Delta t = t_2 - (t_0 + t_1) < 0$

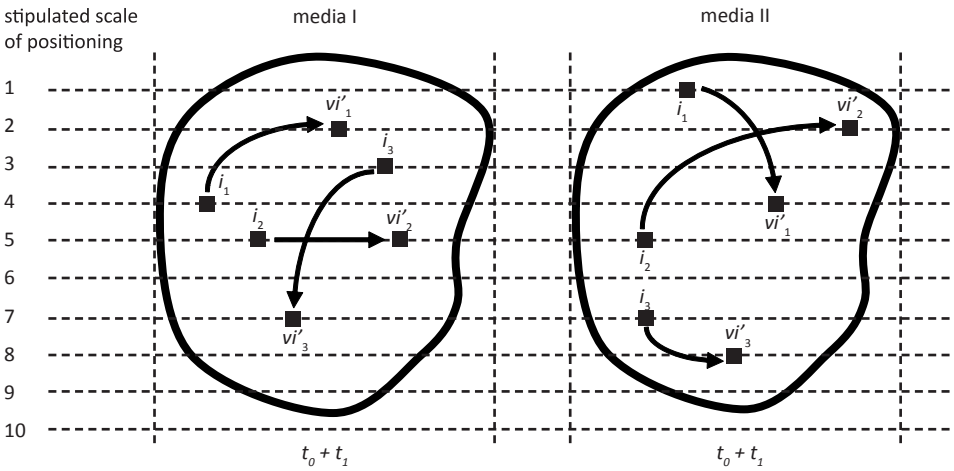

Fig. 5. Varied information positioning by media in the same time slot t_0 t_1

Determination of kinematics and dynamics of information in media sphere depends mainly on the degree of its formalization and the use of innovative methods for studying it. Formalized in this way, the structure will be characterized with a significant degree of objectivism, yet due to the fact that the choice of sphere of attributes is always subjective, and it is particularly true in the case of a media sphere because of the multitude of individual and institutional media entities, it is necessary to find a research tool which will make it possible to obtain more objective results and predict events to a degree. This will be possible by using artificial intelligence methods which I am currently working on.

A media sphere contains a large multitude and variety of information. There are information items concerning events in the social environment, constant and ongoing data related to external conditions (e.g. information on temperature, atmospheric pressure, wind force and direction, precipitation, radiation, CO_2 emissions, data obtained directly from the outer space, etc.) It also contains information generated by the media, in the form of media-based facts, pseudo-events, or even factoids. Information and collections of information generated by the media impact our associations, establish the background for and predict subsequent events, etc. Generated by mass media, the sphere of communication follows its own rules, therefore understanding the dynamics with which it emerges is of great importance for studying media communication itself. As an example I will use information on the case of homicide in Międzybrodzie, near Sanok, in the region of Podkarpacie, on 9 January 2013, and media reports on another event, called "shooting in Sanok". The analyzed area of information concerning these events comprises a total of 48 hours, even though news containing updates (about the progress in investigations) appeared regularly, every few days in the media, on local websites and on Facebook. In each case, such news items contained a review of the events – "from homicide to counter-terrorist operation", opinions concerning the effectiveness of police, local authorities, neighbours of the killer, or the organization of the funeral by the victim's school friends. All this, depending on the news updates, constituted the "distinguished area" of the events, which overlapped and merged with each other. This process is visible even if the analysis of the 48-hour slot, where the relevant information was published by mass media ranging from sub-local to national level, focuses on just one characteristic, namely the density of communications[21]. Seemingly, the two events comprise separate sets of information, because in accordance with the earliest reports, there is only a suspicion that the person central to the events is identical to the "case of homicide" from 9 January, and "the counter-terrorist operation in the city centre of Sanok, after shoots aimed at a police vehicle from windows of a block of flats on a housing estate". Reports on both events, particularly in sub-local and local media, contain a great deal of comment, opinions, speculation, etc. The areas distinguished for both events consti-

[21] The rate of density of communications is the number of media providing the same information in a specified time unit. Methodology designed for examining density of communications, and practical results of this factor in the media sphere have been discussed in the final chapter of my new book: *Nowe podmioty w przestrzeni* (*New entities in media sphere*)..., p. 475–500.

tute two separate areas of communication in the media sphere. They meet and overlap with each other mainly with regard to predicting further events. They mainly constitute information about "what is (was) happening" along the axis of time. Yet, if we put together characteristic features of both events, namely: "density of communications" and "information positioning", we can demonstrate there are areas common for the two events in the time slot under analysis. The following table shows the basic relevant data in accordance with the adopted scale.

Table 1. Relation between "density of communications about events" and their "positioning in the media"

Information	**Media**	**Density scale from 0 to 10**	**Positioning scale from 0 to 10**
		Media	**Significance**
I_1 *– homicide in Międzybrodzie near Sanok,* 09.01.13, 15.53	sub-local	3	10
	local	4	7
	regional	5	6
	national	9	7
I_2 *– events in Sanok 10.01.13 Counter-terrorism operation*	sub-local	3	8
	local	4	9
	regional	5	10
	national	9	9

Based on the above "Table", the graphic image shows the area of possible interrelations between the two sets of information constituting the common area for the analysis of other characteristics reflecting the kinematics and dynamics of the events, and the direction for predictions.

The shaded area, showing the interrelation between the "density of communications" and "positioning" of information in various media, makes it possible to distinguish these characteristics of information, which are recognized by the media as important components of information and used by them to build communications, which later become part of media-based facts, various pseudo-events or a source for an emerging factoid, which is considered to be true because mass media informed about it.

The article proposes an innovative approach to studying information space based on analysis of kinematics and dynamics of information in media sphere. Such an approach was not used before, yet the first results seem to be very interesting and significant from the viewpoint of information policy, at various levels of media communications from sub-local to national mass media. Additionally, a new area of media

management is being developed, and is characterized by the use of devices based on methods of artificial intelligence. Results of modelling and structuring the media sphere make it possible to develop and organize concepts related to the operation of media in the public sphere.

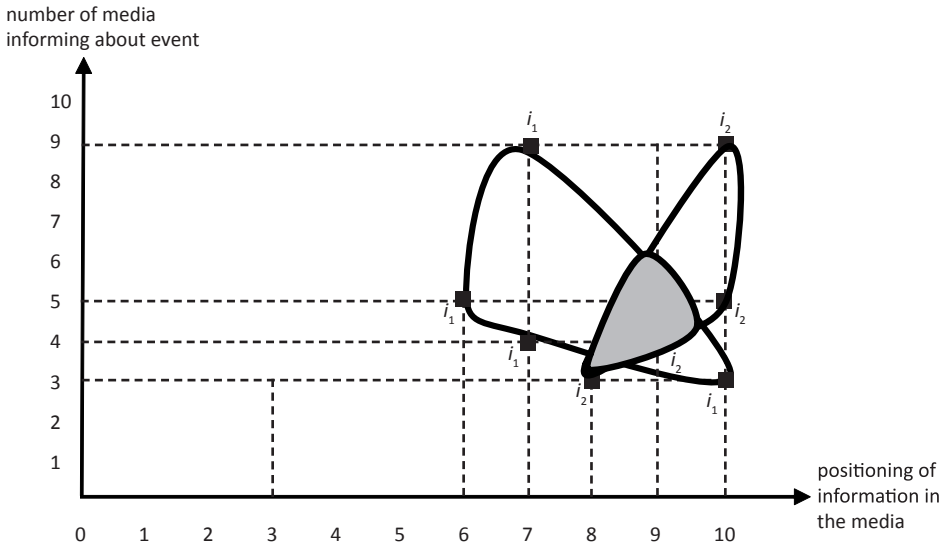

Fig. 6. Area common to the two events. Relation between "density of communications" and "positioning" of information in the media

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